WHAT IS CLAIMED IS:

1. A method for manufacturing a semiconductor device, comprising:

a step of forming a lower silicon oxide film;

a step of forming a silicon film on the lower silicon oxide film; and

a step of forming a silicon nitride film on the lower silicon oxide film to completely nitride the silicon film by a plasma nitriding method, wherein

a multilayered insulating film including at least the lower silicon oxide film and the silicon nitride film is formed.

2. The method for manufacturing the semiconductor device according to claim 1, further comprising:

a step of forming an upper silicon oxide film to oxidize a surface of the silicon nitride film by a plasma oxidizing method, wherein

the multilayered insulating film composed of the lower silicon oxide film, the silicon nitride film, and the upper silicon oxide film is formed.

3. The method for manufacturing the semiconductor device according to claim 1, wherein

the silicon film is formed under a temperature condition of 700℃ or below.

4. The method for manufacturing the semiconductor device according to claim 1, wherein

the silicon nitride film is a charge-storage film of a memory cell.

5. The method for manufacturing the semiconductor device according to claim 2, wherein

the multilayered insulating film is formed as a dielectric film provided between a floating gate and a control gate in the memory cell.

6. The method for manufacturing the semiconductor device according to claim 2, wherein

a gate insulation film is formed in a peripheral circuit region by the plasma oxidizing method simultaneously with the upper silicon oxide film.

7. The method for manufacturing the semiconductor device according to claim 1, wherein

a film thickness of the silicon film is 5 nm or above.

8. The method for manufacturing the semiconductor device according to claim 1, wherein

the silicon nitride film is formed by conducting nitriding processing in which plasma is excited by microwave in an atmosphere of a source gas containing nitrogen to generate a nitrogen radical.

9. The method for manufacturing the semiconductor device according to claim 8, wherein

the source gas does not contain hydrogen.

10. The method for manufacturing the semiconductor device according to claim 2, wherein

the upper silicon oxide film is formed by conducting oxidizing processing in which plasma is excited by microwave in an atmosphere of a source gas containing oxygen to generate an oxygen radical.

11. The method for manufacturing the semiconductor device according to claim 10, wherein

the source gas does not contain hydrogen.

12. A method for manufacturing a semiconductor device, comprising:

a step of forming a silicon nitride film to nitride a surface of a silicon region by a plasma nitriding method; and

a step of oxidizing a surface of a silicon nitride film and an interface of the surface of the silicon region facing with the silicon nitride film simultaneously by a plasma oxidizing method, and of simultaneously forming an upper silicon oxide film on the surface thereof and a lower silicon oxide film on the interface thereof, wherein

a multilayered insulating film composed of the lower silicon oxide film, the silicon nitride film and the upper silicon oxide film is formed.

13. The method for manufacturing the semiconductor device according to claim 12, wherein

the silicon region is an island-shaped floating gate formed in every memory cell, and the multilayered insulating film is a dielectric film

provided between the floating gate and a control gate in the memory cell.

14. The method for manufacturing the semiconductor device according to claim 12, wherein

the silicon region is a semiconductor substrate and the multilayered insulating film is a charge-storage film of the memory cell, and further comprising:

a step of forming a gate electrode on the multilayered insulating film after the multilayered insulating film is formed.

15. The method for manufacturing the semiconductor device according to claim 12, wherein

a gate insulation film is formed in a peripheral circuit region by the plasma oxidizing method simultaneously with the silicon oxide film.

16. The method for manufacturing the semiconductor device according to claim 12, wherein

a film thickness of the silicon nitride film formed by the plasma nitriding method is 15 nm or below.

17. The method for manufacturing the semiconductor device according to claim 12, wherein

the silicon nitride film is formed by conducting nitriding processing in which plasma is excited by microwave in an atmosphere of a source gas containing nitrogen to generate a nitrogen radical.

18. The method for manufacturing the semiconductor device according to claim 17, wherein the source gas does not contain hydrogen.

19. The method for manufacturing the semiconductor device according to claim 12, wherein the silicon oxide film is formed by conducting oxidizing processing in which plasma is excited by microwave in an atmosphere of a source gas containing oxygen to generate an oxygen radical.

20. The method for manufacturing the semiconductor device according to claim 19, wherein the source gas does not contain hydrogen.

21. A method for manufacturing a semiconductor device, comprising:

a step of forming a lower silicon oxide film;

a step of forming a silicon nitride film on the lower silicon oxide film by a CVD method; and

a step of oxidizing a surface of the silicon nitride film by a plasma oxidizing method, wherein

a multilayered insulating film composed of the lower silicon oxide film, the silicon nitride film and an upper silicon oxide film is formed.

22. The method for manufacturing the semiconductor device according to claim 21, wherein the silicon nitride film is a charge-storage film of a memory cell.

23. The method for manufacturing the semiconductor device according to claim 21, wherein

the multilayered insulating film is formed as a dielectric film provided between a floating gate and a control gate in the memory cell.

24. The method for manufacturing the semiconductor device according to claim 21, wherein

a gate insulation film is formed in a peripheral circuit region by the plasma oxidizing method simultaneously with the upper silicon oxide film.

25. The method for manufacturing the semiconductor device according to claim 21, wherein

a film thickness of the silicon nitride film formed by the CVD method is 5 nm or above.

26. The method for manufacturing the semiconductor device according to claim 21, wherein

the silicon nitride film is formed by conducting nitriding processing in which plasma is excited by microwave in an atmosphere of a source gas containing nitrogen to generate a nitrogen radical.

27. The method for manufacturing the semiconductor device according to claim 26, wherein

the source gas does not contain hydrogen.

28. The method for manufacturing the semiconductor device according to claim 21, wherein

the upper silicon oxide film is formed by conducting oxidizing processing in which plasma is excited by microwave in an atmosphere of a source gas containing oxygen to generate an oxygen radical.

29. The method for manufacturing the semiconductor device according to claim 28, wherein

the source gas does not contain hydrogen.

30. A semiconductor memory device, comprising:

a memory cell; including

a semiconductor substrate,

an insulation film including a silicon nitride film having a charge-capture function, formed on the semiconductor substrate,

a gate electrode formed on the semiconductor substrate via the insulation film, and

a pair of impurity diffused layers formed on the semiconductor substrate, wherein

the silicon nitride film is a uniform and dense nitrided film formed by only plasma nitriding through microwave excitation or a series of processing including the plasma nitriding.

31. The semiconductor memory device according to claim 30, wherein

the insulation film is a multilayered insulating film composed of a silicon nitride film on a lower silicon oxide film.

32. The semiconductor memory device according to claim 30, wherein

the insulation film is a multilayered insulating film composed of the lower silicon oxide film, the silicon nitride film, and an upper silicon oxide film.

33. The semiconductor memory device according to claim 31, wherein

either or both of the lower silicon oxide film and/or the upper silicon oxide film is/are (a) uniform and dense oxide film(s) formed by plasma oxidization through microwave excitation.

34. The semiconductor memory device according to claim 33, wherein

a gate insulation film of a transistor as a component of a peripheral circuit is a uniform and dense oxide film formed by plasma oxidization through microwave excitation, and simultaneously formed with the upper silicon oxide film.

35. A semiconductor memory device, comprising:

a semiconductor substrate;

a gate insulation film formed on said semiconductor substrate;

an island-shaped floating gate having a charge-capture function, the charge-capture function being formed on said semiconductor substrate via said insulation film;

a dielectric film formed on said floating gate;

a control gate formed on said floating gate via said dielectric film; and

a pair of impurity diffused layers formed on said semiconductor substrate, wherein

said dielectric film includes a uniform and dense silicon nitride film formed by only plasma nitriding

through microwave excitation or a series of processing including the plasma nitriding.

36. The semiconductor memory device according to claim 35, wherein

said dielectric film is a multilayered insulating film composed of the silicon nitride film formed on a lower silicon oxide film.

37. The semiconductor memory device according to claim 35, wherein

said dielectric film is a multilayered insulating film composed of the lower silicon oxide film, the silicon nitride film, and an upper silicon oxide film.

38. The semiconductor memory device according to claim 36, wherein

either or both of the lower silicon oxide film and/or the upper silicon oxide film is/are (a) uniform and dense oxide film(s) formed by plasma oxidization through microwave excitation.